CENG3420 Lab3 Report

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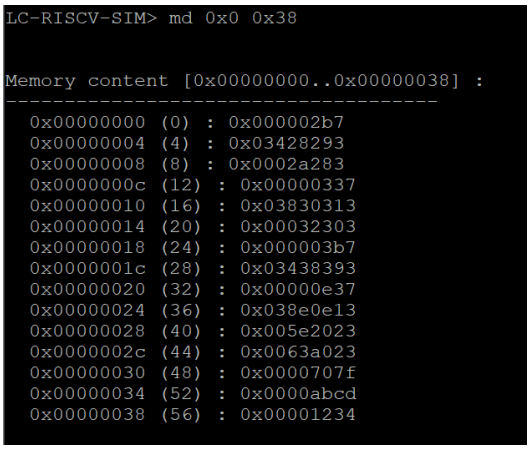
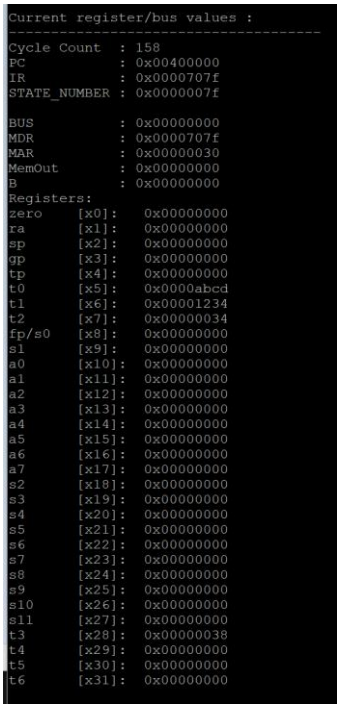
Program of lab3 depends on value in uop. Each digit will determine which gate should be open to bus, the output of mux, and to write or read the memory, etc.

The first program is swap.bin. It is to swap two memory addresses' data. At first, the original memory content is that 0x34 stores "0xabcd", and 0x38 stores "0x1234". The others are the machine code of swap program.



After running the machine code, t0 stores the data in original memory[0x34] and t1 stores the data in original memory[0x38], t2 and t3 stores the memory address respectively.



Also, after running the machine code, it swapped the data in memory[0x34] and memory [0x38]. [0x34] stores “0x1234”, and [0x38] stores “0xabcd”.

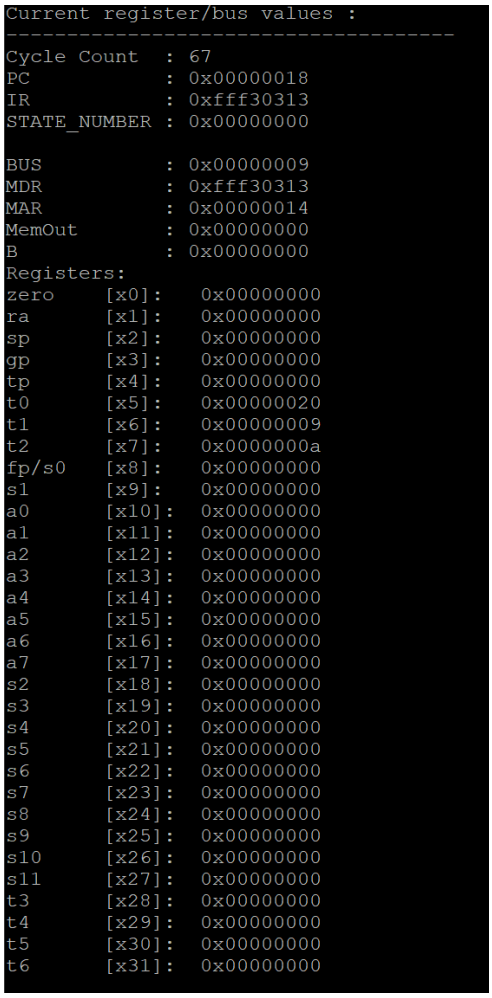
```
Memory content [0x00000000..0x00000038] :
--------------------------------------
  0x00000000 (0) : 0x000002b7
  0x00000004 (4) : 0x03428293
  0x00000008 (8) : 0x0002a283
  0x0000000c (12) : 0x00000337
  0x00000010 (16) : 0x03830313
  0x00000014 (20) : 0x00032303
  0x00000018 (24) : 0x000003b7
  0x0000001c (28) : 0x03438393
  0x00000020 (32) : 0x00000e37
  0x00000024 (36) : 0x038e0e13
  0x00000028 (40) : 0x005e2023
  0x0000002c (44) : 0x0063a023
  0x00000030 (48) : 0x0000707f
  0x00000034 (52) : 0x00001234
  0x00000038 (56) : 0x0000abcd
```

Second program is Count10.bin. It is to let register t2[x7] count up with the number stores in register t1[x6], at the end each loop will decrease t1 by 1 and then will start a new loop unless t1 equals 0. The original register t1[x6] stores 55(0xa).

```
Current register/bus values :
-----------------------------------
Cycle Count  : 37
PC           : 0x0000000c
IR           : 0x0002a303
STATE_NUMBER : 0x00000000

BUS          : 0x0000000a
MDR          : 0x0000000a
MAR          : 0x00000020
MemOut       : 0x00000000
B            : 0x00000000
Registers:
zero     [x0]:   0x00000000
ra       [x1]:   0x00000000
sp       [x2]:   0x00000000
gp       [x3]:   0x00000000
tp       [x4]:   0x00000000
t0       [x5]:   0x00000020
t1       [x6]:   0x0000000a
t2       [x7]:   0x00000000
fp/s0    [x8]:   0x00000000
s1       [x9]:   0x00000000
a0       [x10]:  0x00000000
a1       [x11]:  0x00000000
a2       [x12]:  0x00000000
a3       [x13]:  0x00000000
a4       [x14]:  0x00000000
a5       [x15]:  0x00000000
a6       [x16]:  0x00000000
a7       [x17]:  0x00000000
s2       [x18]:  0x00000000
s3       [x19]:  0x00000000
s4       [x20]:  0x00000000
s5       [x21]:  0x00000000
s6       [x22]:  0x00000000
s7       [x23]:  0x00000000
s8       [x24]:  0x00000000
s9       [x25]:  0x00000000
s10      [x26]:  0x00000000
s11      [x27]:  0x00000000
t3       [x28]:  0x00000000
t4       [x29]:  0x00000000
t5       [x30]:  0x00000000
t6       [x31]:  0x00000000
```

After the first loop, register t1 and t2 store number as picture shown:



Finally, register t1 and t2 will store 0 and 55(0x37), respectively.

```
Current register/bus values :
--------------------------------------
Cycle Count  : 376
PC           : 0x00400000
IR           : 0x0000707f
STATE_NUMBER : 0x0000007f

BUS          : 0x00000000
MDR          : 0x0000707f
MAR          : 0x0000001c
MemOut       : 0x00000000
B            : 0x00000000
Registers:
zero    [x0]:   0x00000000
ra      [x1]:   0x00000000
sp      [x2]:   0x00000000
gp      [x3]:   0x00000000
tp      [x4]:   0x00000000
t0      [x5]:   0x00000020
t1      [x6]:   0x00000000
t2      [x7]:   0x00000037
fp/s0   [x8]:   0x00000000
s1      [x9]:   0x00000000
a0      [x10]:  0x00000000
a1      [x11]:  0x00000000
a2      [x12]:  0x00000000
a3      [x13]:  0x00000000
a4      [x14]:  0x00000000
a5      [x15]:  0x00000000
a6      [x16]:  0x00000000
a7      [x17]:  0x00000000
s2      [x18]:  0x00000000
s3      [x19]:  0x00000000
s4      [x20]:  0x00000000
s5      [x21]:  0x00000000
s6      [x22]:  0x00000000
s7      [x23]:  0x00000000
s8      [x24]:  0x00000000
s9      [x25]:  0x00000000
s10     [x26]:  0x00000000
s11     [x27]:  0x00000000
t3      [x28]:  0x00000000
t4      [x29]:  0x00000000
t5      [x30]:  0x00000000
t6      [x31]:  0x00000000
```

The last program is isa.bin. The original content in memory[0x0] to[0x84] are:

```
Memory content [0x00000000..0x000000a0] :
--------------------------------------
  0x00000000 (0) : 0x00000537
  0x00000004 (4) : 0x08050513
  0x00000008 (8) : 0x00052503
  0x0000000c (12) : 0x00054863
  0x00000010 (16) : 0x00d50893
  0x00000014 (20) : 0x01105863
  0x00000018 (24) : 0x00000537
  0x0000001c (28) : 0x08050513
  0x00000020 (32) : 0x00150583
  0x00000024 (36) : 0x7ff5c613
  0x00000028 (40) : 0x00052503
  0x0000002c (44) : 0x00a606b3
  0x00000030 (48) : 0x00a60733
  0x00000034 (52) : 0xfff88793
  0x00000038 (56) : 0x0440006f
  0x0000003c (60) : 0x048000ef
  0x00000040 (64) : 0x0500006f
  0x00000044 (68) : 0x03c0006f
  0x00000048 (72) : 0x40a88833
  0x0000004c (76) : 0x00008067
  0x00000050 (80) : 0x00381893
  0x00000054 (84) : 0x0028d693
  0x00000058 (88) : 0x40d006b3
  0x0000005c (92) : 0x4026d713
  0x00000060 (96) : 0x00f6c693
  0x00000064 (100) : 0x40d006b3
  0x00000068 (104) : 0x000004b7
  0x0000006c (108) : 0x08448493
  0x00000070 (112) : 0x00d48423
  0x00000074 (116) : 0x00e6c6b3
  0x00000078 (120) : 0x00d4a823
  0x0000007c (124) : 0x0000707f
  0x00000080 (128) : 0xfffffffe
  0x00000084 (132) : 0xfffffff7
  0x00000088 (136) : 0x00000000
  0x0000008c (140) : 0x00000000
  0x00000090 (144) : 0x00000000
  0x00000094 (148) : 0x00000000
  0x00000098 (152) : 0x00000000
  0x0000009c (156) : 0x00000000
  0x000000a0 (160) : 0x00000000
```

After “la a0”, and “lw a0, 0(a0)”. a0 will store -2 (0xfffffffe)

```
Current register/bus values :
--------------------------------------
Cycle Count  : 37
PC           : 0x0000000c
IR           : 0x00052503
STATE_NUMBER : 0x00000000

BUS          : 0xfffffffe
MDR          : 0xfffffffe
MAR          : 0x00000080
MemOut       : 0x00000000
B            : 0x00000000
Registers:
zero     [x0]:   0x00000000
ra       [x1]:   0x00000000
sp       [x2]:   0x00000000
gp       [x3]:   0x00000000
tp       [x4]:   0x00000000
t0       [x5]:   0x00000000
t1       [x6]:   0x00000000
t2       [x7]:   0x00000000
fp/s0    [x8]:   0x00000000
s1       [x9]:   0x00000000
a0       [x10]:  0xfffffffe
a1       [x11]:  0x00000000
a2       [x12]:  0x00000000
a3       [x13]:  0x00000000
a4       [x14]:  0x00000000
a5       [x15]:  0x00000000
a6       [x16]:  0x00000000
a7       [x17]:  0x00000000
s2       [x18]:  0x00000000
s3       [x19]:  0x00000000
s4       [x20]:  0x00000000
s5       [x21]:  0x00000000
s6       [x22]:  0x00000000
s7       [x23]:  0x00000000
s8       [x24]:  0x00000000
s9       [x25]:  0x00000000
s10      [x26]:  0x00000000
s11      [x27]:  0x00000000
t3       [x28]:  0x00000000
t4       [x29]:  0x00000000
t5       [x30]:  0x00000000
t6       [x31]:  0x00000000
```

After “blt a0, zero, L1” and “addi a7, a0, 13”, a7 will store 11 (0x0000000b)

```
Current register/bus values :
-------------------------------------
Cycle Count  : 107
PC           : 0x00000024
IR           : 0x00150583
STATE_NUMBER : 0x00000000

BUS          : 0xffffffff
MDR          : 0xffffffff
MAR          : 0x00000081
MemOut       : 0x00000000
B            : 0x00000000
Registers:
zero    [x0]:   0x00000000
ra      [x1]:   0x00000000
sp      [x2]:   0x00000000
gp      [x3]:   0x00000000
tp      [x4]:   0x00000000
t0      [x5]:   0x00000000
t1      [x6]:   0x00000000
t2      [x7]:   0x00000000
fp/s0   [x8]:   0x00000000
s1      [x9]:   0x00000000
a0      [x10]:  0x00000080
a1      [x11]:  0xffffffff
a2      [x12]:  0x00000000
a3      [x13]:  0x00000000
a4      [x14]:  0x00000000
a5      [x15]:  0x00000000
a6      [x16]:  0x00000000
a7      [x17]:  0x0000000b
s2      [x18]:  0x00000000
s3      [x19]:  0x00000000
s4      [x20]:  0x00000000
s5      [x21]:  0x00000000
s6      [x22]:  0x00000000
s7      [x23]:  0x00000000
s8      [x24]:  0x00000000
s9      [x25]:  0x00000000
s10     [x26]:  0x00000000
s11     [x27]:  0x00000000
t3      [x28]:  0x00000000
t4      [x29]:  0x00000000
t5      [x30]:  0x00000000
t6      [x31]:  0x00000000
```

Finally, a0 to a7 store -2, -1,-2048,23,-7,10, 13,52 respectively.

```
Current register/bus values :
-------------------------------------
Cycle Count  : 363
PC           : 0x00400000
IR           : 0x0000707f
STATE_NUMBER : 0x0000007f

BUS          : 0x00000000
MDR          : 0x0000707f
MAR          : 0x0000007c
MemOut       : 0x00000000
B            : 0x00000000
Registers:
zero    [x0]:   0x00000000
ra      [x1]:   0x00000040
sp      [x2]:   0x00000000
gp      [x3]:   0x00000000
tp      [x4]:   0x00000000
t0      [x5]:   0x00000000
t1      [x6]:   0x00000000
t2      [x7]:   0x00000000
fp/s0   [x8]:   0x00000000
s1      [x9]:   0x00000084
a0      [x10]:  0xfffffffe
a1      [x11]:  0xffffffff
a2      [x12]:  0xfffff800
a3      [x13]:  0xfffffffe
a4      [x14]:  0xfffffff9
a5      [x15]:  0x0000000a
a6      [x16]:  0x0000000d
a7      [x17]:  0x00000068
s2      [x18]:  0x00000000
s3      [x19]:  0x00000000
s4      [x20]:  0x00000000
s5      [x21]:  0x00000000
s6      [x22]:  0x00000000
s7      [x23]:  0x00000000
s8      [x24]:  0x00000000
s9      [x25]:  0x00000000
s10     [x26]:  0x00000000
s11     [x27]:  0x00000000
t3      [x28]:  0x00000000
t4      [x29]:  0x00000000
t5      [x30]:  0x00000000
t6      [x31]:  0x00000000
```

After running the program, the value in memory[0x8c] is 0x17, and memory[0x94] is 0xfffffee.

```
LC-RISCV-SIM> md 0x0 0xa0


Memory content [0x00000000..0x000000a0] :
----------------------------------------
  0x00000000 (0) : 0x00000537
  0x00000004 (4) : 0x08050513
  0x00000008 (8) : 0x00052503
  0x0000000c (12) : 0x00054863
  0x00000010 (16) : 0x00d50893
  0x00000014 (20) : 0x01105863
  0x00000018 (24) : 0x00000537
  0x0000001c (28) : 0x08050513
  0x00000020 (32) : 0x00150583
  0x00000024 (36) : 0x7ff5c613
  0x00000028 (40) : 0x00052503
  0x0000002c (44) : 0x00a606b3
  0x00000030 (48) : 0x00a60733
  0x00000034 (52) : 0xfff88793
  0x00000038 (56) : 0x0440006f
  0x0000003c (60) : 0x048000ef
  0x00000040 (64) : 0x0500006f
  0x00000044 (68) : 0x03c0006f
  0x00000048 (72) : 0x40a88833
  0x0000004c (76) : 0x00008067
  0x00000050 (80) : 0x00381893
  0x00000054 (84) : 0x0028d693
  0x00000058 (88) : 0x40d006b3
  0x0000005c (92) : 0x4026d713
  0x00000060 (96) : 0x00f6c693
  0x00000064 (100) : 0x40d006b3
  0x00000068 (104) : 0x000004b7
  0x0000006c (108) : 0x08448493
  0x00000070 (112) : 0x00d48423
  0x00000074 (116) : 0x00e6c6b3
  0x00000078 (120) : 0x00d4a823
  0x0000007c (124) : 0x0000707f
  0x00000080 (128) : 0xfffffffe
  0x00000084 (132) : 0xfffffff7
  0x00000088 (136) : 0x00000000
  0x0000008c (140) : 0x00000017
  0x00000090 (144) : 0x00000000
  0x00000094 (148) : 0xffffffee
  0x00000098 (152) : 0x00000000
  0x0000009c (156) : 0x00000000
  0x000000a0 (160) : 0x00000000
```